Revegetation and Land Rehabilitation of Oil Shale Mining Sites

by:

Ellis F. Sedgley
State Resource Conservationist
Soil Conservation Service, USDA
Denver, Colorado

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Introduction

The commercial development of oil shale will undoubtedly create severe environmental disturbances.

If the growing demands by society for adequate environmental restoration are to be met, it is imperative that those charged with land rehabilitation understand the basic capabilities of the land with which they are dealing.

The 17,000 square miles of commercial oil shale lands present a diverse array of soils and vegetation in a complex landscape. Soils and plant communities have evolved under widely diverse climatic conditions, but, in general, they have evolved together to form distinctive and identifiable plant-soils units. Each plant community with its soils has unique characteristics which indicate its capabilities and potential for uses to meet man's needs.

The planner must be able to identify the desired future use of mining sites; evaluate the site regarding its capability for that use; and identify the alternatives and potential for acceptable rehabilitation. He must be fully aware of the present technology available and the status of on-going research. Through careful planning, he must see that site factors are manipulated to produce, within reason, the most favorable circumstances for successful revegetation and rehabilitation of the land.

Planned manipulation of site factors such as soil placement, slope gradient, and aspect can appreciably influence the number of alternatives and the chance for success in revegetation efforts.

Ecological Factors

As previously stated, the pattern of vegstative communities of the oil shale area is complex. Elevations vary from less than 5000 feet in the semi-arid Uintah Basin to over 8500 feet along the southern edge of the Piceance Creek Watershed. Precipitation zones follow the elevations and vary from 7 inches to 24 inches. The harsh topography provides a variety of slopes, aspects, and geologic parent materials upon which the plant communities have evolved.

To further complicate the situation, an irregular pattern of abnormal biotic influences has been imposed upon the land by man's activities; principally livestock grazing and the manipulation of big game populations.

In order to understand revegetation potentials, some knowledge of basic ecological processes is necessary.

"As vegetation develops, the same area becomes successively occupied by different plant communities. This process is termed plant succession." 1/
"The climax formation represents the highest type of vegetation possible under its particular climate". 1/

1/ Plant Ecology, Weaver & Clements, McGraw Hill 1938.

Classic examples of plant succession include the hydrosere where a shallow lake evolves from a submerged stage plant community to a climax forest or the xerosere where bare rock follows a different successional course to climax forest.

"Every complete sere ends in a climax when a point is reached where the occupation and reaction of the dominants or dominant are such as to exclude the invasion of other dominants". 1/

If natural or artificial factors other than climate prevent the final or climax stage a "subclimax" may be maintained. Climax plant communities may regress into lower stages or "disclimaxes" as a result of abnormal disturbances usually by man or his domestic animals.

While these facts are basic, they are important in understanding and interpreting vegetative maps and inventories.

Plant communities may be described in very broad terms for large geographical areas or they may be described in more detail for smaller areas.

A vegetative description may cover only the contemporary vegetation or it may attempt to delineate the potential or climax plant communities. It may even indicate the degree of departure from identified potential plant communities.

Projected Land Use

The kinds of land comprising the oil shale country can be classified broadly as forest and rangeland. The present primary use of these lands is obviously grazing by livestock and wildlife. Important secondary uses include recreation, watersheds, and esthetics.

Oil shale development will require new and intensive uses of relatively large areas. Where necessary, range and forest lands will be used for roads, utility corridors, commercial sites, new urbanizing areas, waste disposal sites, etc.

The range and forest sites of the oil shale country vary greatly in their degree of fragility or ability to withstand disturbance. Once disturbed, they present a number of alternatives for revegetation including various successional stages of the natural plant community or the establishment of a variety of exotic plant communities.

Where soils are drastically changed, plant successional communities and the potential vegetation may be unknown. This would be particularly true of soils mixed with highly alkaline or saline waste materials.

Projected or planned land use should depend largely upon the capability of the disturbed site to produce the kind and amount of vegetation needed for that use.

Kuchler in the National Atlas recognizes nine broad categories of vegetation occurring in the oil shale region. Terwilliger and Cook 2/ recognize 17 categories of contemporary vegetative communities in the Piceance Creek Basin. The U.S. Soil Conservation Service describes 45 potential plant communities occurring in the oil shale region and has developed a guide for determining departure from climax in these sites.

It is important to evaluate plant communities not only on the basis of what is growing there now, but also from the standpoint of what might grow there if abnormal disturbance factors are removed.

It is a mistake to assume that the vegetation of the oil shale area is pristine. The land has been grazed for a hundred years by cattle and sheep. The selective grazing by uncontrolled numbers of livestock prior to the Taylor Grazing Act created a landscape of disclimaxes that prevail to this day.

Pioneer ranchers at Rangely, Colorado, remember when Douglas Creek was a live stream in a grassy valley that could be crossed by horse and buggy. Today the streambed is in a gully 30 feet deep and fifty yards wide. The creek flows intermittently and the vegetation is primarily black greasewood.

There are still relict areas and fenceline contrasts that indicate dense sagebrush communities were once dominated by perennial grasses.

2/ Surface Rehabilitation of Land Disturbances resulting from Oil Shale Development Phase I Report, Colorado State University, March 1, 1974.

Do we want to restore the present vegetation on disturbed areas or can we replace it with something better?

Vegetative Communities

As has been previously indicated, vegetative communities may be described in various ways. The vegetative type or aspect is perhaps the simplest and most easily recognized unit for broad planning. It is usually identified by the dominant species that gives the site a distinctive appearance.

The oil shale region can readily be divided into seven major types. These are saltbush, greasewood, pinyon-juniper, sagebrush, mountain shrub, aspen, and conifers.

These types generally occur in relation to elevation as they are listed above with saltbush at the lowest elevations and conifers at the highest.

In the Piceance Creek Basin, pinyon-juniper, sagebrush, and mountain shrub types constitute 90 percent of the total area. In the Uintah Basin, the saltbush type accounts for 75 percent of the vegetation. The Washakie Basin is dominated by the sagebrush type which covers 70 percent of the area.

While vegetative types may be useful for broad planning, they have limited value for appraising the revegetation potential on specific areas.

The sagebrush type, for example, occurs at elevations from 3,000 feet to 11,000 feet. Within this type, up to 22 potential plant communities may be identified as having a wide range of species combinations and revegetation potentials.

The pinyon-juniper type has a complex successional pattern that probably includes the effects of natural fires. Heavy grazing tends to weaken grass-shrub communities and allows adjacent pinyon-juniper stands to invade the disturbed site. If man protects the trees from natural fire, they may persist and present a woodland aspect to a site having high potential for grass-shrub plant communities.

Revegetation Needs & Technology

Revegetation needs relating to oil shale development fall into two broad categories; disturbed areas and waste disposal sites.

Disturbed areas include roads, building sites, utility corridors, and overburden deposits.

Disposal sites are unique to the oil shale industry because of the nature of waste materials produced.

Present technology is generally adequate to assure successful revegetation of most disturbed areas. Revegetation objectives may be obtained through

natural plant establishment and succession, receeding of native species, or establishment of exotic plant communities.

Federal agencies including the U. S. Forest Service, Soil Conservation Service, Agricultural Research Service and the Bureau of Land Management have been successfully revegetating disturbed range lands for many years.

SCS records show that over 16 million acres of disturbed rangelands have been successfully revegetated.

Thousands of acres in the plains have been seeded to superior strains of native grasses resulting in reestablishment of near potential plant communities. This has been done because the potential plant community contains only a few dominants and they produce more forage than adapted exotics.

Plant communities in the oil shale region have a more complex composition and occur on sites that favor establishment of the highly productive exotic wheat grasses. For this reason, little revegetation has been done using native species.

Very little is known about the potential for revegetating shale waste deposits. Recent research by oil companies, Colorado State University, and others indicate that revegetation of spent shale is possible.

Demonstration plots have been established to show that spent shale from several processes will support vegetation if the material is leached, mulched,

waste material appear to have possibilities.

Research Needs

There are presently a variety of plant testing and research efforts in progress that relate to the oil shale lands.

The Colony Development Operation has been testing plants for several years at its pilot oil shale facility. The U.S. Forest Service has done exhaustive studies on the reestablishment of browse species at Ephraim, Utah. The Soil Conservation Service has been testing native and exotic plants for thirty years. Present SCS facilities at Los Lunas, New Mexico, and Bridger, Montana, service the oil shale area. Several research studies are in progress at Colorado State University, including a two-year study of revegetation potentials financed by industry, state, and national government.

It is essential that the planner have access to all available information before a mining plan is developed.

There are obvious voids in the available knowledge that indicate research needs. There is probably duplication of effort in some areas of research.

Some apparent research needs include:

1. Further study of the reactions of vegetation to shale waste materials.

2. Studies of the successional stages of plant development on disturbed or reconstituted sites.

3. Testing of the major native plants and development of superior strains for special revegetation purposes.

4. Special studies to develop revegetation criteria for the salt desert shrub type.

5. Development of ability to reestablish near potential plant communities on disturbed sites.

Another problem the planner may face is the unavailability of desired plant materials. Many of the native species are not available in quantity. It takes 4 to 5 years of lead time to produce an adequate supply of presently unavailable species.

The destruction of young plants by wildlife is a serious deterrent to successful revegetation. This presents yet another obstacle to the planner.

The successful revegetation of oil shale sites will not be easy, but obviously, it can be done if present technology is fully utilized and research is planned to acquire necessary additional knowledge.